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12a. DISTRIBUTION / AVAILABILITY STATEMENT

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13. ABSTRACT *(Maximum 200 words)*

This project sought to improve hands-on access to modern instrumentation and enhancement of students' classroom learning experiences in two physics courses. The outcomes of this instrumentation award have been to double the capacity of the introductory laboratory course and expand the number and variety of physics demonstrations and lab experiments. One unanticipated outcome has been the flexibility to expand course offerings to a second sequence of calculus-based physics. This addition has allowed students who enter the university unprepared for the regular calculus course to keep up the physics sequences so that they are not a year behind of others in their major field. This project has affected over 140 students per year. Students have increased their use of computers to solve problems, analyze results of experiments, and are transferring these skills across courses and majors on a routine basis. Faculty have increased the number and variety of both demonstrations of physics principles and in the experiments they design for student. exercises. All goals and objectives for this project have been met or exceeded.

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Final Performance Report

St. Mary's University's Physics Department's project funded by AFOSR entitled "Laboratory Computer and Lecture Demonstration Instrumentation" has more than succeeded in meeting its objectives to give our students both hands-on access to modern laboratory instrumentation and to enhance their classroom learning experience. It has allowed us to double of our introductory laboratory course capacity. We are now regularly running two introductory laboratories simultaneously, one for general algebra-physics, one for calculus-physics.

An unforeseen outcome is the added flexibility that this equipment has given us in that it allowed the expansion of our offerings. We have added a second sequence of calculus-based physics that starts in the spring along with the second term of the calculus-based course that starts in the fall. This course allows students who don't pass the calculus readiness test when they arrive in the fall to start their sophomore year in sync with their calculus-ready classmates. Thus, they will not be a discouraging year behind when they start their sophomore year.

Our algebra-based physics classes are now approaching a hundred students per term. These students are typically biology majors in their junior or senior year, whereas the students in the calculus-physics courses are typically freshmen or sophomores. These classes are accommodating about forty students through the two term sequence every year.

The instrumented computers are allowing our students the hands-on experiences we desired. They are able to take their data using a computer and analyze their results on the same machine. There are enough machines so that every pair of students has access to a computer and experimental setup. For example: In studying the harmonic oscillator (a mass hanging from a spring), an ultrasonic distance measuring probe allows the computer to follow the actions of the mass as it bobs up and down. The data are analyzed to show the change in distance, velocity and acceleration with time. The relationship between these quantities has been discussed in class, but here having the student experimentally determine these results and see that they are consistent with the theoretical model derived in class reinforces the lesson.

Most of our other experiments make use of the other probes along with the computers purchased through the grant. This includes a number of new computerized experiments such as the determination of the absolute zero of temperature using both the new pressure and temperature probes simultaneously. Varying the temperature of a sealed flask and observing the change in internal pressure that results demonstrates that they are linearly related to each other. Extrapolating the temperature to where the pressure becomes zero is the location of absolute zero.

One of the more pleasing improvements is that even when the experiment or exercise does not require it, the students regularly use the computers to reduce their laboratory data. This practice is the result of the computer being always at hand, and the students have used it enough to be comfortable with it.

The new lecture demonstration equipment enhances the lecture component of our course. For example, the standing wave apparatus allows us to show the students the similarity between the standing waves in a tube and those on a string. This demonstration illustrates the power of physics models in that the equations and concepts developed to examine the standing waves on a string can be applied to sound waves in air as well. The physics laser disk has rounded out our collection of demonstration videos that show many demonstrations that are too difficult to set up or that have animation that greatly enhances the students' understanding of what is happening.

The laptop computer is used both to aid in astronomy course presentations and to speed up the use of our telescope for celestial observing by students. The money saved on the computers was put toward the purchase of a combination Michelson Fabry-Perot interferometric system that gives us a high quality instrument to run laboratory exercises for the introductory classes as well as allow the advanced students to use this interferometric system to measure some of the more subtle phenomena of modern physics. This term the modern laboratory class measured the fine line shift between the spectral lines of hydrogen and its isotope deuterium.

We have observed in the labs that students are transferring knowledge about the use of this equipment and computer-aided analysis to other courses. Therefore, one objective to increase the use of modern equipment in problem-solving has also been met. Over all, this equipment has made a significant difference in the responses of students to lab experiences and in the number and types of experiments we are able to conduct to demonstrate physics principles. We believe we have more than met the original goals of this project.